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PATENT ABSTRACTS OF JAPAN

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(54) MANUFACTURE OF OPTICAL FILM, OPTICAL FILM AND LIQUID CRYSTAL
DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To manufacture a biaxial optical film in which control of a refractive index distribution is easy and the uniformity in high by setting a solution of a film forming material on the base plate, forming an optically negative uniaxial film being dried and oriented in its face, and stretching this film into biaxial film.

SOLUTION: An optically negative uniaxial film is formed by disposing a solution of film making material on a base plate to subsequently be dried and oriented in its face. At this time, for such a base plate, there is employed an oriented film such as a plastic film having an appropriate thickness. Also, a film thickness of the negative uniaxial film is made relatively small with respect to a thickness of the base plate. The negative uniaxial film is stretched so as to form a biaxial film. This operation is conducted such that the negative uniaxial film is heated with an stretched film as a base plate. By this process, an optical film can be manufactured which has a high uniformity, an easy control of a refractive index distribution and the high quality, and demonstrates an excellent function.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display which contains this optical film in optically biaxial optical films suitable as various optical films, such as a phase contrast film and a polarization film, and those manufacturing methods, and a list.

[0002]

[Description of the Prior Art] The optically biaxial film which controlled the refractive index of three dimensions is useful in the optical field using polarization. The importance of such a film that can especially control polarization in the field of a liquid crystal display finely is high.

[0003] Many of optical films of the form birefringence which can be used for a current industrial target have optically uniaxial refractive-index structure. There are a thing forward in axial, a negative thing and a thing that has an optical axis in a film plane, a thing which exists in the direction of a film normal. For example, the color compensation film used for the STN (Super Twisted Nematic) liquid crystal display is a forward optically uniaxial film which has an optical axis in a field. Moreover, Harris and others has acquired the negative optically

uniaxial structure of having an optical axis in the direction of a film normal, by drying the solution of a specific polymer on a substrate and carrying out plane orientation of the polymer, for example (U.S. Pat. No. 5344916, No. 6480964, and No. 5580950). This manufacturing method deserves attention as a simple manufacturing method of an optical film. However, with an optically uniaxial optical film with high symmetric property, there is a limitation in the effectiveness in control of the polarization etc. naturally.

[0004] On the other hand, an optically biaxial film can be produced by biaxial stretching of a polymer film, and has the report of a large number about this. However, there is a problem in the quality of the film obtained. That is, in order to control the refractive-index structure of a three way by balance of extension of two directions, refractive-index control is difficult and it is difficult for the obtained film to obtain a uniform film that it can be tended in a field to perform distribution of refractive-index structure.

[0005] Thus, when producing an optically biaxial film industrially, the big technical problem is left behind.

[0006]

[Problem(s) to be Solved by the Invention] The purpose of this invention has control of refractive-index distribution in offering the approach of manufacturing an easy and homogeneous optically biaxial high optical film.

[0007] It can manufacture easily, refractive-index distribution is correctly controlled by the desired value, and another purpose of this invention is to offer a homogeneous high optical film.

[0008] The refractive index of the transmitted light is controlled correctly, and another purpose of this invention has the high engine performance, and is to offer the liquid crystal display which can be manufactured easily.

[0009]

[Means for Solving the Problem] As an approach of acquiring 2 shaft structures, this invention persons did not depend only on extension, but as a result of considering using two different technique gradually and performing ***** examination based on it, they reached this invention at last.

[0010] That is, according to this invention, the manufacturing method of the optical film characterized by including the process which was allotted and dried on the substrate and carried out plane orientation of the membrane formation ingredient solution, and which obtains a negative optically uniaxial film optically, and the process which extends said negative optically uniaxial film and is used as an optically biaxial film is offered.

[0011] Moreover, according to this invention, the manufacturing method of said optical film characterized by said substrate being an oriented film is offered.

[0012] Furthermore, according to this invention, in the process which extends said negative optically uniaxial film, the manufacturing method of said optical film characterized by extending heating said negative optically uniaxial film with said oriented film is offered.

[0013] Furthermore, according to this invention, the optical film obtained according to said manufacturing method is offered.

[0014] Furthermore, according to this invention, said optical film characterized by distribution of the projection direction to the film plane of a film optical axis being less than 2° is offered.

[0015] Furthermore, according to this invention, the liquid crystal display component characterized by including said optical film is offered.

[0016]

[Embodiment of the Invention] The approach of this invention is an approach of manufacturing an optical film, and is an approach of manufacturing the optically biaxial optical film which has especially the refractive-index structure of $n_y > n_x > n_z$. In this specification, n_x , n_y , and n_z are the principal indices of refraction of three directions of x directions, the direction of y, and the direction of z, respectively, x directions and the direction of y are the directions of [in the film plane which intersects perpendicularly mutually], and the direction of z is made into the direction of thickness of a film.

[0017] By the approach of this invention, the process (henceforth the 1st process) which was allotted and dried on the substrate and carried out plane orientation of two steps of processes which form a film, i.e., the membrane formation ingredient solution, and which obtains a negative optically uniaxial film optically, and the process (henceforth the 2nd process) which extends said negative optically uniaxial film and is used as an optically biaxial film are included, controlling a refractive index.

[0018] Especially as said substrate used for the 1st process, it is not limited but a plastic plate, a glass plate, or metal plates, such as plastic film, etc. can be used. If oriented films, such as plastic film which has thickness suitable as a substrate, are used, especially since both negative optically uniaxial films and substrates can be extended in the 2nd process, it is desirable.

[0019] Especially the latter is desirable, although what performed extension actuation can be mentioned after forming membranes as said plastic film through the thing made by the cast method, or the melting condition of a polymer. This is because a more precise negative 1 shaft film can be transformed, when the direction of the latter film discovers a certain amount of [a substrate] reinforcement in the 2nd extension process.

[0020] As said plastic film, polyolefines, such as polyethylene and polypropylene, Polyimide, polyamidoimide, a polyamide, polyether imide, A polyether ether ketone, a polyether ketone, poly ketone

sulfide, Polyether sulfone, polysulfone, polyphenylene sulfide, Polyphenylene oxide, polyethylene terephthalate, polybutylene terephthalate, Films, such as polyethylenenaphthalate, polyacetal, a polycarbonate, polyarylate, acrylic resin, polyvinyl alcohol, polypropylene, cellulose system plastics, an epoxy resin, and phenol resin, can be mentioned. Especially, polyethylene, polypropylene, polyethylene terephthalate, polyethylenenaphthalate, especially a cellulose plastic, etc. are desirable. Moreover, what performed surface treatment, such as hydrophilization processing and hydrophobing processing, can also be used for these plastic film.

[0021] Thickness of said plastic film can usually be set to 20 micrometers or more 200 micrometers or less, and is 60 micrometers or more 100 micrometers or less especially preferably 30 micrometers or more 150 micrometers or more preferably. Since there is a possibility that extension unevenness may arise when it extends with said negative optically uniaxial film in the 2nd process, since the reinforcement of a film is weak when thinner than 20 micrometers, it is not desirable. In the case of 200 micrometers or more, since there is a possibility that required tension may become large too much in extension, and it may not be suitable for industrial production, it is not desirable.

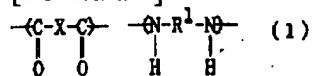
[0022] The solution which contains membrane formation ingredients, such as various kinds of polymers and a low molecular weight compound in which a polymerization is possible, as said membrane formation ingredient solution can be used. In order to acquire form birefringence large enough (i.e., in order for $n_x - n_z$ to obtain a negative, optically uniaxial film large enough), the thing containing a membrane formation ingredient with at least one or more kinds of aromatic series rings is desirable.

[0023] The low molecular weight compound which can give various kinds of polymers, such as a polyamide which specifically has at least one or more kinds of aromatic series rings as said membrane formation ingredient, polyimide, polyamic acid, polyester, or polyester amide, or these polymers and in which a polymerization is possible can be mentioned. These may be used independently, and it may mix and they may be used.

[0024] The polymer which includes the polymerization unit expressed with the following type (1), for example as said polyamide is mentioned.

[0025]

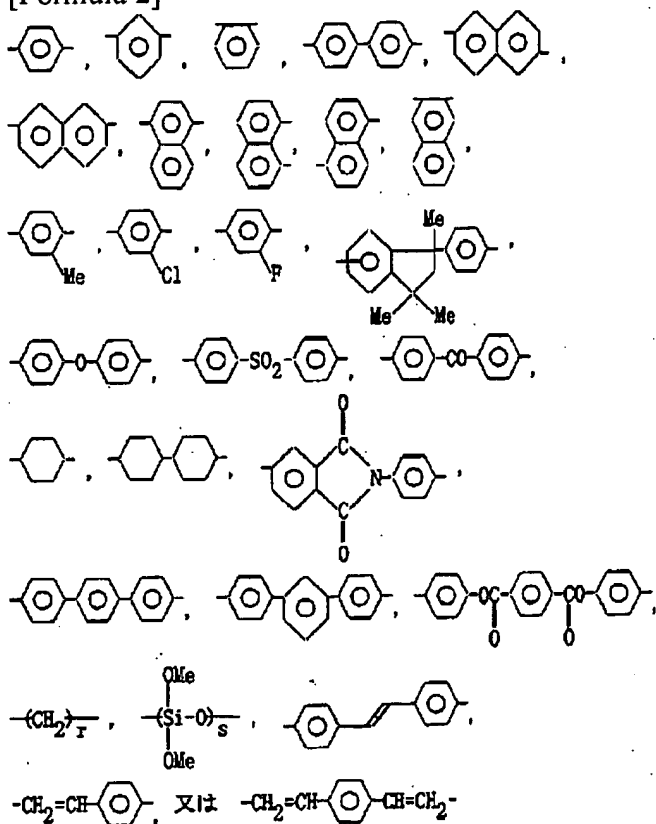
[Formula 1]

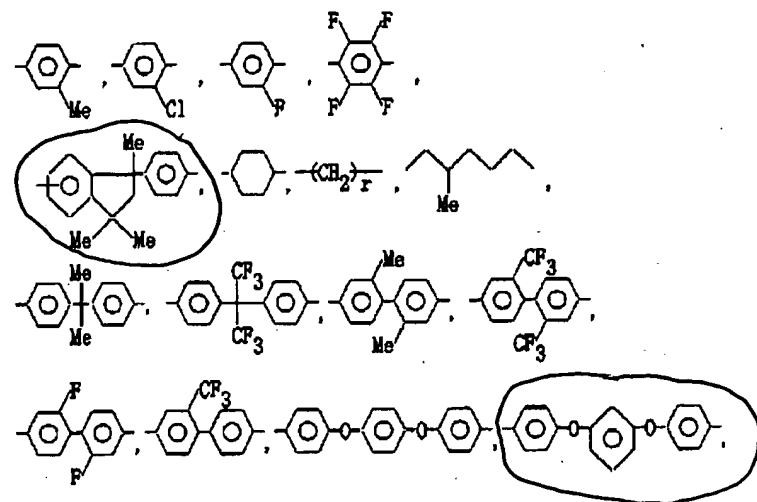


[0026] The inside X and R¹ of a formula is the residue of arbitration, and is radicals in which at least one side contains a ring.

[0027] Said X is [0028].

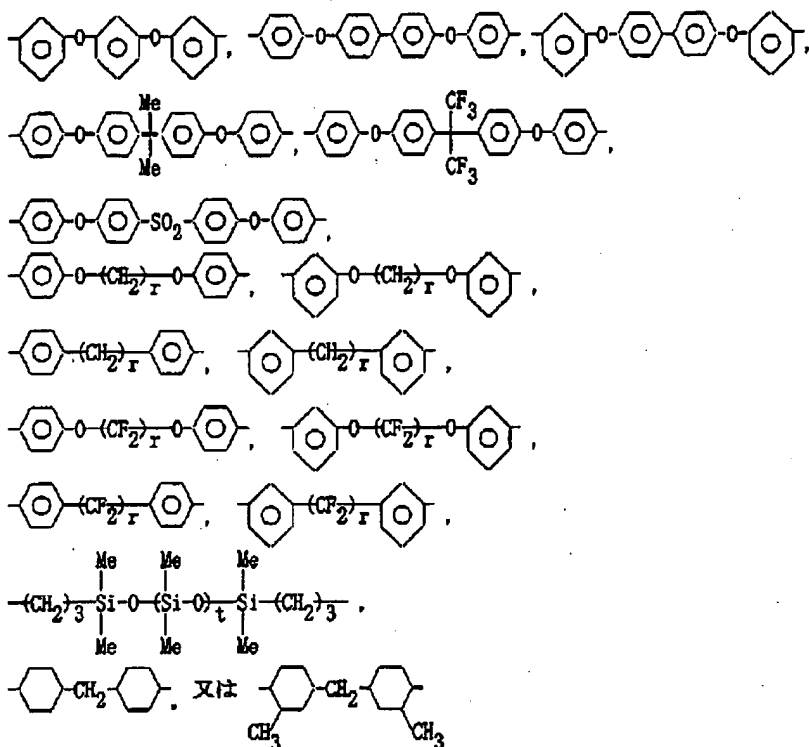
[Formula 2]





R - админ

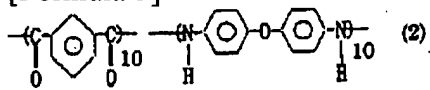
R - админ



[0032] It is desirable that it is the radical of **. However, as for the inside r of a formula, the number of 2-12 is shown, s shows the number of 1-500, and t shows the number of 0-500.

[0033] More specifically as said polyamide, it is the polymer expressed with the following type (2), and [0034].

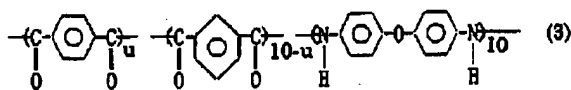
[Formula 5]



structure 3 (w) ?
no

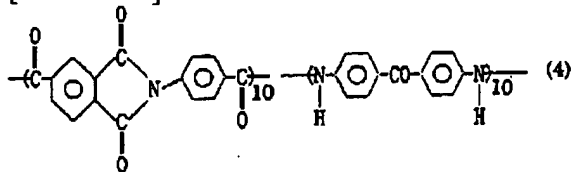
[0035] The polymer, [0036] which are expressed with a formula (3)

[Formula 6]



[0037] The polymer, [0038] which are expressed with a formula (4)

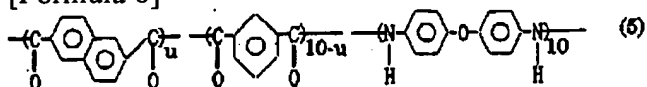
[Formula 7]



[0039] The polymer expressed with a formula (5) to a list can be mentioned.

[0040]

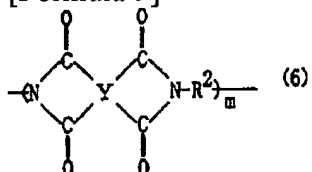
[Formula 8]



[0041] However, u shows the number of $0.5 \leq u \leq 9.5$.

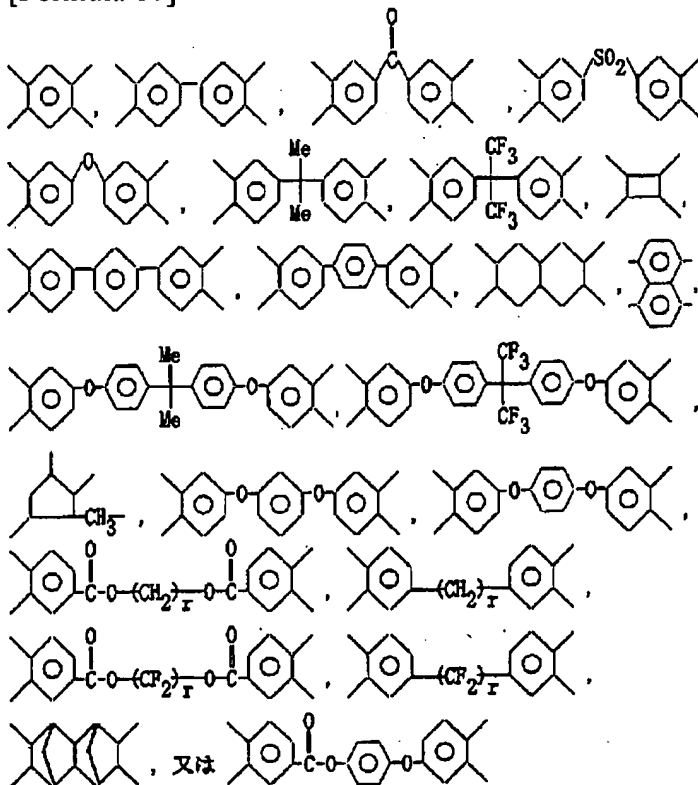
[0042] As said polyimide, it is polymer: [0043] shown, for example by the following formula (6).

[Formula 9]



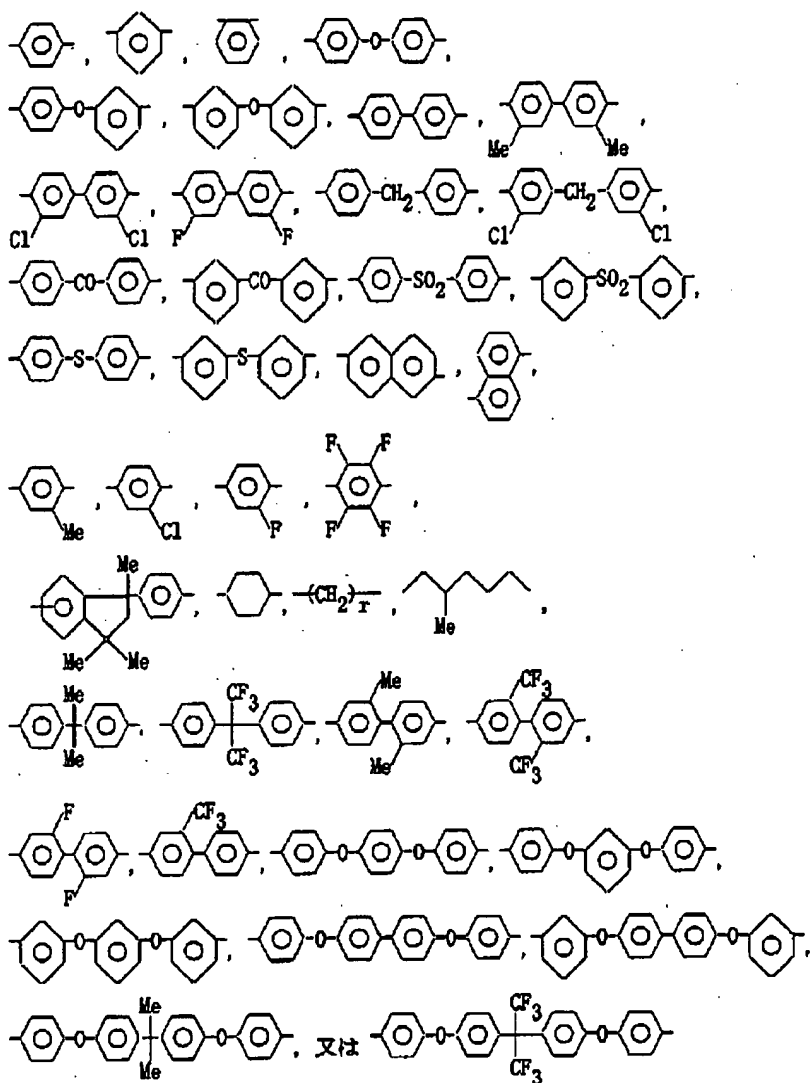
[0044] (The inside m of a formula is average degree of polymerization.) Moreover, Y is [0045].

[Formula 10]



[0046] The radical of ** is shown and R2 is [0047].

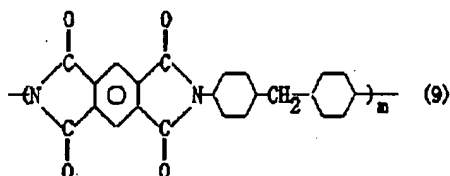
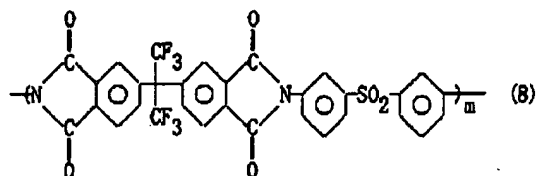
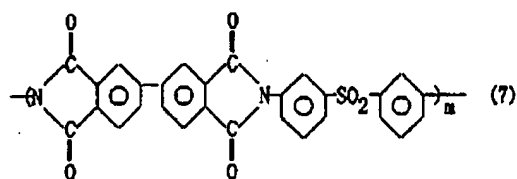
[Formula 11]



[0048] The radical of ** is shown. It can mention and, more specifically, the polymer shown by following type (7) - (9) can be mentioned.

[0049]

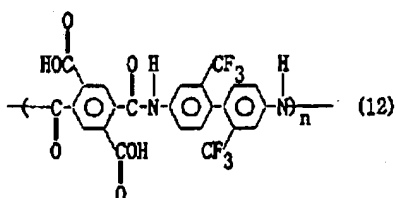
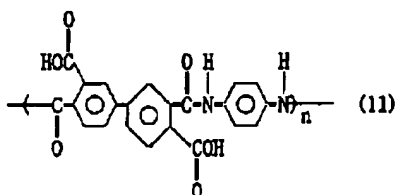
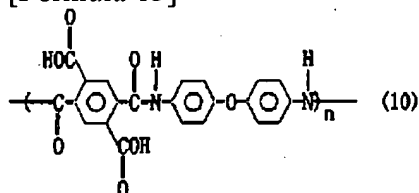
[Formula 12]



[0050] As said polyamic acid, the polymer shown, for example by following type (10) - (12) can be mentioned.

[0051]

[Formula 13]



[0052] (The number of 2-400 is shown by the inside n of a formula.)

In addition, when using said polyamic acid, after solution-applying and drying, the 2nd process can also be performed as it is, but the 2nd process can also be presented after imide-izing by heat treatment.

[0053] the concentration of said membrane formation ingredient in said membrane formation ingredient solution -- usually -- it can take still more preferably for 20 or less % of the weight 2% of the weight or more 30 or less % of the weight 1% of the weight or more preferably 40 or less % of the weight 0.5% of the weight or more.

[0054] In said membrane formation ingredient solution, it can choose suitably according to the membrane formation ingredient and substrate to be used that what is necessary is just what can dissolve said membrane formation ingredient and does not corrode a substrate film to the degree of pole as a solvent in which said membrane formation ingredient is dissolved. Specifically For example, chloroform, dichloromethane, a carbon tetrachloride, a dichloroethane, Tetrachloroethane, TORITORI chloroethylene, tetrachloroethylene, Halogenated hydrocarbon, such as a chlorobenzene and an orthochromatic dichlorobenzene Phenols, such as a phenol and parachlorohenol, benzene, toluene, Aromatic hydrocarbon, such as xylene, methoxybenzene, 1, and 2-dimethoxybenzene An acetone, ethyl acetate, t-butyl alcohol, a glycerol, ethylene glycol, Triethylene glycol, ethylene glycol monomethyl ether, Diethylene-glycol wood ether, propylene glycol, dipropylene glycol, The 2-methyl -2, 4-pentandiol, ethyl Cellosolve, butyl Cellosolve, These mixed solvents, such as 2-pyrrolidone, a N-methyl-2-pyrrolidone, a pyridine, triethylamine, dimethylformamide, dimethylacetamide, an acetonitrile, butyronitrile, and a carbon disulfide, etc. are used. Moreover, a sulfuric acid can also be used depending on the membrane formation ingredient to be used.

[0055] In addition to said membrane formation ingredient and solvent, said membrane formation ingredient solution may add other additives, such as a surfactant, according to the purpose.

[0056] In said 1st process, especially the method of arranging said membrane formation ingredient solution on said substrate is not limited, but can be performed by the spin coat method, the roll coat method, the die coat method, etc. After allotting on a substrate so that the film which can obtain said membrane formation ingredient solution by these approaches may become desired thickness, a negative optically uniaxial film can be obtained by making it dry. Although drying temperature can be suitably chosen according to the class of solvent etc., 40 degrees C or more 250 degrees C or less can usually be preferably made into 50 degrees C or more 200 degrees C or less. Desiccation may be performed under constant temperature, and gradually, temperature is raised and may be performed. The drying time can usually be preferably made below into for 15 minutes more than for 2 minutes still more preferably below for 20 minutes more than for 30 seconds below for 30 minutes more than for 10 seconds.

[0057] Although a polymer can consider as the negative optically uniaxial film which carried out plane orientation (phenomenon which an anisotropy produces in molecular orientation since the paint film which contains a solvent at the time of desiccation contracts in the direction of thickness) by arranging a membrane formation ingredient solution on a substrate, and making it dry when said various kinds of polymers are used as said membrane formation ingredient When the

low molecular weight compound in which a polymerization is possible as said membrane formation ingredient is used, a membrane formation ingredient solution is arranged on a substrate, and after making it dry and obtaining the plane orientation object of a low molecular weight compound, it can consider as a negative optically uniaxial film by constructing a bridge by heat or light if needed.

[0058] Said negative optically uniaxial film means the film with which the principal indices of refraction n_x and n_y fill larger relation than n_z almost identically. If the difference of n_x and n_y is or less 0.001 extent, specifically, it can be used as what has optically uniaxial [negative].

[0059] When a film is created according to said 1st process, the value of the principal indices of refraction n_x , n_y , and n_z is a value to which it comes as *****, if dependent on the usually used ingredient and the conditions to produce, can choose thickness according to the purpose and can control the retardation value ($n_x - n_z$) (value acquired by the product of Thickness d) of the thickness direction in the field which is an important parameter optically.

[0060] The large thing to some extent of the difference of the refractive index of field inboard and the refractive index of the thickness direction, i.e., $n_x - n_z$, is desirable, and it is [0.002 or more / 0.005 or more] usually preferably desirable [$n_x - n_z$ / 0.01 or more] in said negative optically uniaxial film, to carry out to 0.02 or more preferably especially still more preferably. Thickness of a film must be thickened in order to obtain the retardation of the request about the thickness direction in a field, when this refractive-index difference is small. Since uniform structure becomes is hard to be acquired in an extension process when this thickness is too thick so that it may state later, as for the value of $n_x - n_z$, it is desirable that it is 0.002 or more.

[0061] the retardation value of the thickness direction of said negative optically uniaxial film, i.e., ($n_x - n_z$), the value given by x_d , -- usually -- 20nm or more 2000nm or less 50nm or more 1000nm or less can be more preferably set to 100nm or more 600nm or less still more preferably. In the case of less than 20nm, a retardation value is too small, and since there is a possibility that the function as an optical element may be missing, it is not desirable. Since there is a possibility of unevenness being made and giving an uneven film at the time of spreading or desiccation when exceeding 2000nm, it is not so desirable. moreover, the thickness of said negative optically uniaxial film -- usually -- 0.2 micrometers or more 100 micrometers or less 0.5 micrometers or more 50 micrometers or less can be preferably set to 1 micrometers or more 20 micrometers or less still more preferably. In the case of less than 0.2 micrometers, although based also on the birefringence value ($n_x - n_z$) of a film, since there is a possibility that the function as an optical element may be missing since a retardation value becomes small generally, it is not desirable. Since there is a

possibility of unevenness being made and giving an uneven film at the time of spreading or desiccation when exceeding 100 micrometers, it is not desirable.

[0062] Moreover, when extending said negative optically uniaxial film with said substrate in the 2nd next process, as for the thickness of said negative optically uniaxial film, it is desirable that it is smaller than the thickness of said substrate, and its small thing is still more desirable than the one half of the thickness of said substrate. By making small relatively thickness of said negative optically uniaxial film to the thickness of said substrate, when these [both] are extended, uniform extension can be performed.

[0063] The approach of this invention includes the 2nd process which extends said negative optically uniaxial film and is used as an optically biaxial film following said 1st process.

[0064] When a glass plate or a metal plate is used as said substrate, said extension can perform the negative optically uniaxial film obtained according to the 1st process, after it exfoliates from a substrate. When oriented films, such as plastic film which, on the other hand, has thickness suitable as said substrate, are used, said negative optically uniaxial film can be extended with a substrate, without exfoliating from a substrate.

[0065] Since uniform extension can be performed compared with the case where said negative optically uniaxial film is independently extended since tension was imposed on said substrate, said substrate extended to homogeneity and said negative optically uniaxial film was indirectly extended with this uniform extension when said negative optically uniaxial film was extended with said oriented film etc., it is desirable. When thickness of said negative optically uniaxial film is relatively made small to the thickness of said substrate and these [both] are extended especially, especially since tension is mainly imposed on said substrate and uniform extension is attained, it is desirable.

[0066] Said extension has desirable ** performed heating said negative optically uniaxial film with said oriented film as a substrate. More than the glass transition point of ****, whenever [stoving temperature] can be made below into the melting point, and can be suitably chosen by a class, draw magnification, etc. of a substrate. Usually, 40 degrees C or more 250 degrees C or less 80 degrees C or more 220 degrees C or less can be preferably made into 100 degrees C or more 200 degrees C or less still more preferably. Since big tension is imposed with a substrate and it becomes impossible to control extension of said negative optically uniaxial film in case of the temperature which needed huge tension for performing relations a total as it is under glass transition point temperature, and exceeded the melting point, it is not desirable.

[0067] The uniaxial-stretching actuation which applies tension to an one direction, or the biaxial-stretching actuation to which tension is

applied in the two directions which intersect perpendicularly mutually can perform said extension. However, in the approach of this invention, since the negative optically uniaxial anisotropy has already been acquired at said 1st process, in order to obtain an optically biaxial film, uniaxial-stretching actuation is enough. Moreover, actuation is simple and the uniaxial-stretching actuation also from a viewpoint that equipment acquires uniform refractive-index distribution simply is more desirable than biaxial-stretching actuation.

[0068] the case where said uniaxial stretching is performed -- draw magnification -- usually -- it can take still more preferably for 1.3 or less times 1.05 or more times 1.5 or less times 1.03 or more times preferably 2.0 or less times 1.01 or more times. The effectiveness according that draw magnification is less than 1.01 times to extension is not enough, and since there is a possibility that a film may become only the structure near optically uniaxial [negative], it is not desirable. When draw magnification is larger than 2.0 times, there is a possibility that a film may become uneven refractive-index structure for extension unevenness.

[0069] When tension to which the tension of the direction to which tension larger when performing biaxial stretching than the inside of the extension direction of the 2-way which intersects perpendicularly is applied is applied in the direction which intersects perpendicularly with T_y and it is set to T_x , $T_y/T_x > 3$ can be obtained and an optically biaxial film with to some extent little refractive-index distribution can specifically be obtained by enlarging T_y enough compared with T_x by considering as $T_y/T_x > 5$ and conditions which are $T_y/T_x > 10$ still more preferably more preferably. The T_y/T_x ratio is advantageous when the larger one obtains an optically biaxial film with little refractive-index distribution as much as possible, in the case of $T_x = 0$, it is equivalent to uniaxial stretching, and it is the most desirable. the draw magnification of the direction to which larger tension is applied -- usually -- it can take still more preferably for 1.3 or less times 1.05 or more times 1.5 or less times 1.03 or more times preferably 2.0 or less times 1.01 or more times.

[0070] By performing said extension, only n_y can be changed a lot, without changing the inside n_x and n_z of the three principal indices of refraction a lot, and 2 shaft structures of $n_y > n_x > n_z$ can be acquired. Therefore, the retardation value ($n_y - n_x$) within another field which is an important parameter (x_d) can be controlled by the extension phase, without changing the value of x_d in said negative optically uniaxial film ($n_x - n_z$) a lot. In addition, when the extension direction can usually be made into the direction which has the greatest refractive index among the principal indices of refraction of the said direction of y , i.e., three directions, when said uniaxial stretching is performed, and said biaxial stretching is performed, the extension direction to which said tension of T_y was applied can be made into said direction of y .

[0071] When performing the approach of this invention industrially, it is desirable to form a negative optically uniaxial film on a roll-like substrate in said 1st process, and to perform said extension still more nearly continuously. In this case, the extension direction in the case of performing uniaxial stretching as extension can be made into the longitudinal direction (vertical extension in this case) or the cross direction (horizontal extension in this case) of a roll. From an industrial viewpoint, the vertical extension is easier and it is more desirable. When said vertical extension is performed, said direction of y of the 2 shaft film obtained can usually be made into a roll longitudinal direction. On the other hand, when said horizontal extension is performed, the roll cross direction usually becomes in said direction of y, and the time of vertical extension differs from its direction 90 degrees. Although horizontal extension has the fault that the equipment for extension becomes complicated compared with vertical extension, there is value performed depending on the application of the optical film obtained. For example, since the optical-character ability of a pasting object changes with sense of the maximum refractive-index direction of an optically biaxial film when pasting continuously together the roll-like optically biaxial film obtained by the approach of this invention, and the optical film of the shape of other roll, continuous lamination can be attained more easily [the optically biaxial film manufactured by horizontal extension in respect of optical-character ability], and it may be desirable. In addition, although a certain amount of tension for conveyance of a film may be needed also for a longitudinal direction when carrying out horizontal extension, uniaxial stretching of the substantial cross direction can be performed by enlarging tension of crosswise extension enough to the tension of the longitudinal direction in this case.

[0072] Said obtained optically biaxial film is cooled to a room temperature after said extension termination if needed. Especially a limit has neither a cooling rate nor a means. However, since a wrinkling tends to go into the film obtained when the tension at the time of extension was rapidly released before cooling, it is desirable to carry out before release of the tension to which a part or all of a cooling process was applied in said extension.

[0073] When said negative optically uniaxial film is extended with said oriented film, it can also leave, if satisfactory when said oriented film which is a substrate can be removed after an extension process if needed or a product is used.

[0074] Although it is possible also for considering as the optical film of this invention which is a product as it is, since the optically biaxial film obtained according to the above process is the usually comparatively thin film, it is more desirable to imprint to other substrates (henceforth "the 2nd substrate" in distinction from said substrate used at the 1st process) different from what was used at said

1st process, and to consider as the optical film of this invention. Subsequently said imprint can perform the optically biaxial film and the 2nd substrate on said substrate using adhesives or a binder lamination and by exfoliating and removing only said substrate by the interface with said optically biaxial film, for example.

[0075] Although it will not be limited especially if it has moderate smoothness as the 2nd substrate used for an imprint, it is transparent and glass, the plastic film which has the optical isotropy are desirable. As an example of this plastic film, films, such as polymethacrylate, polystyrene, a polycarbonate, polyether sulfone, polyphenylene sulfide, polyarylate, amorphous polyolefine, triacetyl cellulose, or an epoxy resin, can be raised. Polymethylmethacrylate, a polycarbonate, polyarylate, triacetyl cellulose, polyether sulfone, etc. are used preferably especially. Moreover, optically, an anisotropy substrate can also be used as the 2nd substrate, when it is a member required for the application made into the purpose. As an example of the 2nd substrate of an anisotropy, such a phase contrast film that extends plastic film, such as a polycarbonate and polystyrene, and is obtained, a polarization film, etc. are mentioned optically.

[0076] Although there will be especially no limit if the adhesives or the binder which sticks the 2nd substrate used for an imprint and an optically biaxial film is the thing of optical grade, things, such as acrylic, an epoxy system, and an urethane system, can be used.

[0077] The approach of said exfoliation can illustrate the approach of exfoliating mechanically, the approach of guessing a supersonic wave and exfoliating in said poor solvent, the approach of giving a temperature change and exfoliating using the difference of the coefficient of thermal expansion of said substrate and said optically biaxial film, etc., after being immersed in the approach of exfoliating mechanically using a roll etc., and the poor solvent to all the stuck ingredients of the structure. Since detachability changes with adhesion of the ingredient used for the optically biaxial film, and said substrate, the approach which was most suitable for the system can be used for it.

[0078] Moreover, although the front face of the obtained 2 shaft film can be used as the optical film of this invention which is a product even if it remains as it is, if needed, a protective layer can be prepared in a front face, adhesion processing can be performed, or it can perform surface treatment, and can also use it as a product.

[0079] What combined said optically biaxial film or said optically biaxial film, and the 2nd substrate can be combined with other films for optics, for example, a phase contrast film, a polarizing plate, etc. which have other refractive-index structures, remaining as it is or if needed, and can be used as the optical film of this invention which is a product. In the formal polarizing plate which protected the ***** polyvinyl alcohol film for the iodine of the format specifically manufactured generally industrially with the two substrates film, said

optically biaxial film can be incorporated, and it can unify, and can also consider as the optical film of this invention which is a product. [0080] The manufacturing method of this invention can manufacture the optical film of this invention with high homogeneity, and since control of refractive-index structure is easy, it can manufacture the optical film with high quality which demonstrates the outstanding function. According to the manufacturing method of this invention, the field of a liquid crystal display can especially manufacture the optical film which can also meet such a demand enough, although the homogeneity of an optical member and the validity of a parameter to be used are evaluated very severely since it is the application of which it complains to vision.

[0081] When the optical film of this invention projects an optical axis on a film plane, the distribution can usually be made into less than $\times 5$ times, if the coating edge of a membrane formation ingredient solution is removed. If the approach of extending said both negative optically uniaxial films is adopted using said oriented film as a substrate, distribution of less than $\times 3$ times can usually be acquired, and if the homogeneity of extension temperature and the homogeneity of extension tension control on high conditions, $\times 2$ control is also possible. If it furthermore limits in the case of uniaxial stretching, and conditions are usually controlled less than $\times 2$ times, $\times 1$ time and a maximum of $\times 0.5$ control can be attained.

[0082] Especially the application of the optical film of this invention can be used as a elliptically-polarized-light plate combined with the phase contrast film and the polarizing plate, although not limited.

[0083] The liquid crystal display of this invention contains the optical film of said this invention.

[0084] Especially the format of the liquid crystal display of this invention is not limited. For example, a STN (SuperTwisted Nematic) cel, TN (Twisted Nematic) cel, VA (Vertical Aligned) cel, An OCB (Optically Controlled Birefringence) cel, A HAN (Hybrid Aligned Nematic) cel, And what performed regular orientation division to these, the thing which performed random orientation division, Various kinds of cels shall be included. Moreover, a simple matrix method, The active-matrix method using a TFT (Thin Film Transistor) electrode, an MIM (Metal Insulator Metal) electrode, etc., Various kinds of drive methods which impress driver voltage to the field inboard of a cel, such as an IPS (In-Plane Switching) method and a plasma addressing method, shall be taken. moreover, the thing of the transparency mold equipped with the back light system or the thing of a reflective mold which offered the reflecting plate -- it can also consider as the thing of a projection mold further.

[0085] Although especially a mode equipped with said optical film in the liquid crystal display of this invention is not limited, it is between a polarizing plate and a drive cel, and can usually mention the mode

which arranges one sheet or the two or more sheet aforementioned optical film in the location of a drive cel top and/or the bottom. The mode which arranges every one sheet of the film concerned to drive cel a top and the bottom especially is desirable. Furthermore, it can also consider as the mode combined with the phase contrast film which has different refractive-index structure from another film for optics, for example, the optical film of this invention, the dispersion film, the lens sheet, etc.

[0086]

[Effect of the Invention] When the manufacturing method of the optical film of this invention includes the process which obtains a specific negative optically uniaxial film, and the process which extends it, control of refractive-index distribution can manufacture an easy and homogeneous high optical film.

[0087] Since the optical film of this invention is an optical film obtained according to said manufacturing method, it can manufacture easily and refractive-index distribution is correctly controlled by the desired value, and its homogeneity is high and is useful as a phase contrast film, a elliptically-polarized-light plate, etc.

[0088] Since the liquid crystal display of this invention contains the optical film of said this invention, the refractive index of the transmitted light is controlled correctly, it is high and its engine performance is useful as a liquid crystal display which can be manufactured easily.

[0089]

[Example] Although an example is described below, this invention is not limited to these. In addition, each analysis method used in the example is as follows.

(Chemical structure decision) It measured by 400MHz ¹H-NMR (JEOL JNM-GX400).

(Polarization analysis) Ellipsometer by MIZOJIRI OPTICAL Co., Ltd. It carried out using DVA-36VWLD.

(Refractometry) the product made from ATAGO -- it carried out using Abbe refractometer Type-4T.

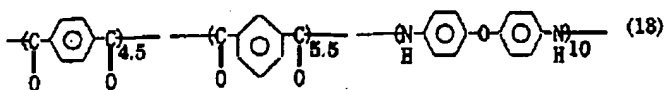
(Thickness measurement) Kosaka Laboratory Make -- highly precise -- thin film level difference measuring instrument ET-10 were mainly used.

[0090] Moreover, the approach of asking for thickness from the data of interference wave measurement (Jasco ultraviolet, visible, and near-infrared spectrophotometer V-570) and a refractive index was also used together.

(Example 1) The polyamide expressed with a formula (13) was compounded as a membrane formation ingredient.

[0091]

[Formula 14]



[0092] The intrinsic viscosity of this polyamide was 1.6 dl/g (30 degrees C, N-methyl-2-pyrrolidone (NMP) solution of 0.5 g/dl). This polyamide was dissolved in NMP and 6% of the weight of the membrane formation ingredient solution was prepared. This membrane formation ingredient solution was used for the polyethylenenaphthalate film (Teijin, Ltd. make) with the thickness of 80 micrometers, a die length [of 30cm], and a width of face of 20cm, the spin coat method was applied, desiccation processing was performed in 80-degree C oven for 1 hour, and the laminated film was obtained. Several sheets of this laminated film were prepared. Subsequently, uniaxial stretching was carried out by various draw magnification which shows each laminated film in Table 1 with constant speed (10 mm/min) in 150-degree C oven. Extension went in the die-length direction of said laminated film. A part of each laminated film after extension was cut down, the polyamide film was exfoliated, these were made into the sample, and refractometry and thickness measurement were performed. A result is shown in Table 1.

[0093]

[Table 1]

試料番号	延伸倍率	膜厚 (μm)	n_y	n_x	n_z
1	延伸無し	6.3	1.687	1.687	1.665
2	1.16	5.9	1.707	1.688	1.667
3	1.24	5.8	1.713	1.684	1.664
4	1.32	6.0	1.720	1.682	1.662

[0094] While the polyamide film (sample number 1) which is not extended from the refractive index of three directions had the negative optically uniaxial structure of $n_y=n_x>n_z$, it turned out that the extended polyamide film (sample numbers 2-4) has the optically biaxial structure of $n_y>n_x>n_z$. The maximum refractive-index direction y was an extended direction here.

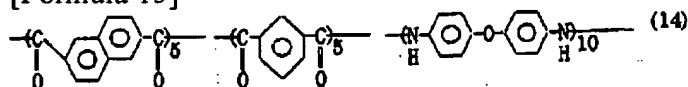
[0095] Since the exfoliation polyamide film itself was a thin film and it was lacking in free-standing The imprint to other transparence substrates of the polyamide film was performed using the remaining part which was not used for said measurement of said laminated film. the transparent soda glass plate (1.1mm in thickness) which applied the binder to the front face is prepared, and a binder and the polyamide film touch said laminated film on it -- as -- lamination -- subsequently the polyethylenenaphthalate film was exfoliated. Thus, the laminating glass which equipped the front face with the polyamide film which has optically biaxial refractive-index structure was able to be obtained. When the situation of unevenness was observed on both sides of the obtained laminating glass to the polarizing plate under the cross

Nicol's prism of two sheets, it turned out that the film of a uniform polymer is obtained.

(Example 2) The polymer expressed with a formula (14) was compounded as a membrane formation ingredient.

[0096]

[Formula 15]



[0097] The intrinsic viscosity of this polymer was 1.5 dl/g (30 degrees C, NMP solution of 0.5 g/dl). This polymer was dissolved in NMP and the membrane formation ingredient solution of 4 % of the weight of polymer concentration was prepared.

[0098] On the polyethylene terephthalate film with width of face of 40cm, a die length [of 500m], and a thickness of 80 micrometers, the roll coater was used, this membrane formation ingredient solution was applied continuously, desiccation processing was carried out at 100 degrees C, and the laminated film was obtained. It extended by applying the tension of 55Kgf(s) to a longitudinal direction, heating this laminated film at 150 degrees C. The longitudinal direction was contracted 1.09 times and the laminated film after extension had contracted elongation and the cross direction about 0.95 times. The thickness of the polymer layer on the laminated film after extension was 10 micrometers.

[0099] The polyethylene terephthalate film had homogeneous low form birefringence in the field, and since it was not desirable when measuring optical property, the next exfoliation imprint actuation was performed.

[0100] First, ultraviolet curing mold adhesives were applied on the polymer layer on the extended laminated film, and the triacetyl cellulose film (die length 500m, ** of 40cm, the thickness of 80 micrometers, Fuji Photo Film make) was laminated on it. After irradiating ultraviolet rays and stiffening adhesives, polyethylene terephthalate was exfoliated from the polymer layer and the laminated material of a triacetyl cellulose film and a polymer layer was obtained.

[0101] Polarization analysis of the obtained laminated material was carried out. Each angle on which those with two and an optical axis form an optical axis with the normal of laminated material was 38 degrees. Moreover, the direction which projected the optical axis on the field of laminated material was in agreement with the longitudinal direction of laminated material.

[0102] Moreover, this laminated material was cut down 1m, the retardation within a field was measured every other cm about a longitudinal direction and the cross direction, and distribution was investigated (however, a polymer layer removes 5cm of both ends of the cross direction of the part by which the laminating was carried

out). Consequently, it turned out that a retardation value is in the range of $2.13\text{nm} \sim 2\text{nm}$, and form birefringence can be controlled by less than $\sim 1\%$ of precision. Therefore, it turned out that the obtained laminated material is a uniform optically biaxial film.

(Example 3) Using the same membrane formation ingredient solution as an example 2, and the polyethylene terephthalate film, spreading and desiccation were performed similarly and the laminated film was prepared. Horizontal extension was carried out using the tenter, heating this laminated film at 180 degrees C. Lateral tension was set to 0.9Kgf(s) per die length of 1cm, and applied the tension (per [0.07] cm Kg(s)) of 3Kgf to the longitudinal direction for conveyance. Film width increased about 6% by extension. The polymer layer was imprinted on the triacetyl cellulose film like the example 2 after extension, and the laminated material of a triacetyl cellulose film and a polymer layer was obtained.

[0103] Polarization analysis of the obtained laminated material was carried out. Each angle on which those with two and an optical axis form an optical axis with the normal of laminated material was 24 degrees. Moreover, distribution according [the direction which projected the optical axis on the field of laminated material] to the location within the field of laminated material almost in accordance with the cross direction of laminated material was ~ 1 time. Moreover, distribution of the retardation within a field was less than $\sim 2\%$. Therefore, it turned out that the obtained laminated material is a uniform optically biaxial film.

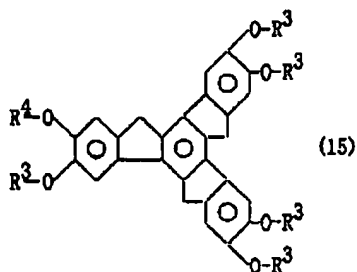
(Example 4) The optical element which unified the polarizing element and optically biaxial film as one of the modes of the optical film of this invention was produced.

[0104] Iodine was infiltrated into the extended polyvinyl alcohol film, this was pasted up on the triacetyl cellulose film using heat-curing mold adhesives, and polyvinyl alcohol-triacetyl cellulose laminated material was obtained. Next, heat-curing mold adhesives were applied on the polymer layer on the laminated material of the triacetyl cellulose film and polymer layer which were obtained in the example 3, lamination and heat were applied the polyvinyl alcohol film side of said polyvinyl alcohol-triacetyl cellulose laminated material, and adhesives were stiffened. In addition, it was made, as for the direction of lamination, for the extension direction of the polyvinyl alcohol film and the roll longitudinal direction of the laminated material of an example 3 to become parallel. Thus, the optical element which has a polarization layer and a birefringence layer between the triacetyl cellulose films of two sheets was producible.

(Example 5) The compound of a formula (15) was compounded.

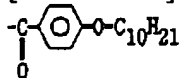
[0105]

[Formula 16]



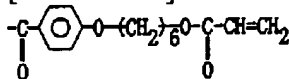
[0106] (The inside R3 of a formula is [0107].)

[Formula 17]



[0108] It comes out, the radical expressed is shown and R4 is [0109].

[Formula 18]

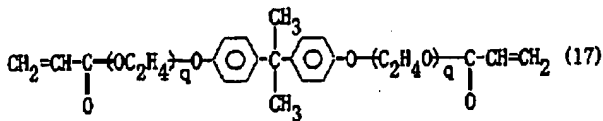
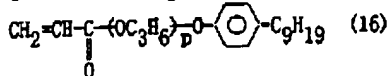


[0110] It comes out and the radical expressed is shown.

Moreover, the compound of a formula (16) and a formula (17) came to hand (respectively Toagosei ARONIKKUSU M-117 and M-210).

[0111]

[Formula 19]



[0112] (The inside p and q of a formula is average polymerization degree, and is about 4 and about 2, respectively.)

these compounds -- compound [of a formula (15)]: -- it mixed by the weight ratio of compound =50:45:5 of a formula (compound:type (17 of 16)), and considered as the start raw material for a polymer film. In addition, although it was the compound which has a discotic liquid crystal phase if the compound of a formula (15) was independent, said start raw material did not show liquid crystallinity, but was a **** Yuna liquid under the room temperature.

[0113] In addition, photoinitiator IRUGAKYUA 907 (product made from Ciba-Geigy) was used as the membrane formation ingredient constituent to said start raw material 1.5% of the weight. The diethylene-glycol wood ether solvent was added to this, and the solution of 15 % of the weight of membrane formation ingredient constituent concentration was prepared.

[0114] Having used the spin coat method for the polyphenylene sulfide film (Toray Industries, Inc. make) with the thickness of 50

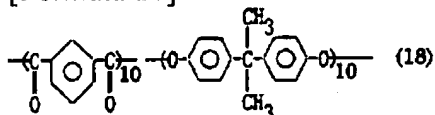
micrometers, a die length [of 30cm], and a width of face of 20cm, having applied this solution to it, having performed desiccation processing for 10 minutes in 80-degree C oven, and keeping temperature at 60 degrees C further, the high pressure mercury vapor lamp performed UV irradiation to the spreading side, and carried out photo-curing of the membrane formation ingredient constituent, it was made to polymer-ize, and the laminated film which has a polymer layer was obtained. When the refractive index of the polymer layer on the obtained laminated film was measured, it had negative optically uniaxial structure, and the refractive index within a field was fixed and it turned out that the refractive index of 1.59 and the direction of thickness is 1.56.

[0115] Next, uniaxial stretching of said laminated film was increased to the longitudinal direction 1.1 times with constant speed (10 mm/min) in 200-degree C oven. The refractive indexes of the film after extension were $n_y=1.61$, $n_x=1.58$, and $n_z=1.56$. The polymer layer on the obtained laminated film was imprinted to up to the glass substrate like the example 1. It observed under polarization, consequently it turned out that the polymer layer on a glass substrate has uniform homogeneous optically biaxial structure.

(Example 6) The polymer expressed with a formula (18) was compounded as a membrane formation ingredient.

[0116]

[Formula 20]



[0117] The intrinsic viscosity of this polymer was 0.65 dl/g (30 degrees C, NMP solution of 0.5 g/dl). Dissolved this membrane formation ingredient in NMP, prepared 4% of the weight of the membrane formation ingredient solution, applied to the aluminum plate of 20cm angle, it was made to dry in 80-degree C oven, and the laminate was obtained. The thickness of the polymer layer on this laminate was 45 micrometers. Subsequently, the polymer layer was carefully removed from the aluminum plate, the polymer film was obtained, and this was extended 1.05 times at 140 degrees C. The polymer film after extension was transparent and had optically biaxial. It was 100nm when asked for the retardation which is the product of (n_x-n_z) and thickness in polarization analysis. Moreover, the retardation within the field which are (n_y-n_z) and thickness was about 390nm. When the projection direction to the field of the polymer film of an optical axis was investigated about the range of 10cm angle of a polymer film core, there was **four distribution centering on the extension direction of the polymer film. Moreover, distribution of the retardation within a field was 390nm**18nm.

[Translation done.]

*** NOTICES ***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The manufacturing method of the optical film characterized by including the process which was allotted and dried on the substrate and carried out plane orientation of the membrane formation ingredient solution, and which obtains a negative optically uniaxial film optically, and the process which extends said negative optically uniaxial film and is used as an optically biaxial film.

[Claim 2] The manufacturing method of the optical film according to claim 1 characterized by said substrate being an oriented film.

[Claim 3] The manufacturing method of the optical film according to claim 2 characterized by extending in the process which extends said negative optically uniaxial film, heating said negative optically uniaxial film with said oriented film.

[Claim 4] The optical film obtained according to the manufacturing method of claim 1-3 given in any 1 term.

[Claim 5] The optical film according to claim 4 characterized by distribution of the projection direction to the film plane of a film optical axis being less than **2 degrees.

[Claim 6] The liquid crystal display component characterized by including an optical film according to claim 4 or 5.
